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Ceramics

VOL. IV AUGUST, 1952 NO. 42

POTTERY HOME SALES

THE freeing of decorated ware is some amelioration for restricted exports. However, it means dipping into that "buffer" home market. This was held out as an excuse for stressing overseas exports since the "starved" British home market was always assumed to be "there" for this day!

True in principle when the embargo was placed upon home-decorated ware immediately after the war—then it represented a substantial potential market measured in pounds sterling—then many buyers would have bought decorated pottery in preference to many other articles because of the intrinsic value and continuity of life of a good set of china.

But now we are scraping the barrel for ready money! We have reached the stage where there is too little cash chasing a large number of goods which, of course, means price reductions. The effect of this deflation is, of course, double edged, for when prices fall, it heralds that an era of reduced availability of money is already at hand. One cannot have reduced prices and simultaneous increases in wages! The two do not tie up economically. The financial year 1951-52 has seen the pinnacle reached in terms of profit distribution bearing in mind always that 75 per cent. of these are a direct Exchequer payment to meet the nation's liabilities. Even the 1951-52 profit pinnacle was only reached by industries dealing with prime products such as raw materials and basic commodities—those industries making fabricated goods are already on the decline compared with twelve or eighteen months ago.

Today, the 1939 10s. 6d. china half tea service sells at £4 4s. 0d! The earthenware 7s. 6d. one pre-war sells at 30s!

Which boils down, of course, to keen competition among pottery manufacturers for this home-market trade.

The Treasury cannot afford too great a reduction in profit! The Trades Union Congress is seeing to it that there is not too great a reduction in real wages without calling a showdown. And these irreconcilables can be mediated only by the technician and the manager. But they in turn demand increased capital from profits to be ploughed back into business.

Here the Chancellor can help.

FLUORINE DISCHARGE

by **ARGUS**

ONE notices that this problem was discussed recently in the House. A Stoke farmer, Mr. J. R. Godfrey Smith, complains that, "the cattle . . . reared on my farm have lost their teeth at four years old and are in the same condition as cattle sixteen years old." As a result he found it impossible to build up a self-contained attested herd of Ayrshires as he had been trying to do.

Mr. Ellis Smith, M.P., took up the matter with Sir Thomas Dugdale, Minister of Agriculture. He drew attention to the deleterious effect fluorine emission may have upon cattle, adding that it can surely lead to similar reactions upon children. The medical officer of health for Stoke-on-Trent says that a watch has been kept for years on the matter, but there has been no proof of harm to human beings. Sir Thomas Dugdale adds that there is no cure for fluorine poisoning, and offers little hope to the farmer except that he could limit the time which his stock spends on the land so affected! He says that scrubbers could be installed in the new factories to minimise the emission, but it means more expensive equipment, particularly for the older factories, and he concludes that there is no easy solution!

Anticipated the Problem

In effect, CERAMICS rather anticipated this problem, for the effects of fluorine on human beings was discussed in the August, 1950 issue of the journal. Some opinions from this article might therefore be mentioned again. It seems established that relatively high concentrations of the fluoride ion causes the structure of growing teeth to be changed to give a surface with a mottled appearance—they may still be strong and healthy, but may be somewhat more brittle than the normal tooth. High intake of fluorides in drinking water does affect the bones in the body without necessarily disabling the worker. The general conclusion reached is that the fluorides may be regarded as a general protoplasmic poison, but they do not act as a chronic poison on man if their intake is limited to about 10 mgm. a day.

The water-insoluble fluoride salts such as fluorspar and cryolite have low solubility and little toxic effect—they do not irritate the skin, although it has been said that when inhaled they are slowly absorbed to produce chronic poisoning—the symptoms of fluorine poisoning or fluorosis include bone changes which are revealed by the X-ray as well as vomiting, constipation, dyspnœa after exertion and rheumatic pains—it is suggested that when they are used at high temperatures they may have a sufficiently high vapour pressure to cause fluorine poisoning, but authenticated cases of such poisoning had not been reported as late as 1949.

Used in Ceramic Industry

The soluble non acid-forming fluorides including compounds such as fluosilicates and fluoborates are used widely in the ceramic industry. The dry salts when inhaled as a dust are readily absorbed although experience shows that more than 10 mgm. of sodium fluoride may be ingested daily without harmful effect—the lethal dose is 5-15 grm. of sodium fluoride, and small quantities swallowed by industrial workers in a dusty atmosphere may cause minor nausea and vomiting, but a study of workers exposed to sodium fluoride vapours coming from an open hearth furnace did not show any chronic effects attributable to the vapours. However, it is a different story with the acids and acid-forming fluorine compounds such as hydrofluoric acid, fluoboric acid and fluosilicic acid, as well as the salts which in the presence of water are hydrolysed to give acid solutions. They are corrosive to the skin, giving a range of

changes from minor burning to serious ulcers which heal slowly. Loosened finger nails are said to occur, and far and away the worst offender is, of course, hydrofluoric acid.

Experience has shown that the fatal vapour concentration for a man in good health is so irritating to the eye and to the upper respiratory tract that the only way a lethal dose of the acid fluorides can be received by inhaling without ample warning would be the sudden exposure to a high concentration of the acid compound as a fine spray or dust. Yet it seems that it is not advisable to place full reliance upon this warning given by the eyes and nose as some workers suffering from anaemia or cardiovascular disease might succumb to a circulatory collapse or pulmonary edema when they have been exposed to concentrations which are not too irritating to the eyes and nose. It seems also that workers involved in operations which mean exposure to fluorine compounds which are acid or acid-forming should only be selected initially by medical examination no worker with a doubtful chest X-ray result or suffering from asthma, pulmonary complaints or cardiovascular diseases should be employed in such operations.

Protective Clothing

In working with hydrofluoric acid the following clothing is suggested from American sources gauntlet style neoprene gloves, eyeshields with a large 8-in. visor, a chemical respirator with cartridges for acid gases, acid type neoprene aprons. Safety goggles for those men who wear glasses should be special cover-all goggles to fit over the glasses.

It is possible, however, that in the past the fluorine menace has not made its appearance because one would imagine that in the older intermittent or bottleneck kiln the fluorine compounds emitted would be dissipated through the chimney fairly high up in the air, mixed with the products of combustion from the source of heating in short, there would be a dilution the older kiln was filled relatively slowly, heated relatively slowly and cooled over a longer period, and therefore the fluorine product emission from a batch of ware was, as has been stated, carried out over a relatively longer period.

The installation of tunnel kilns certainly brings the question to a much more important level. Here the batch of ware is heated up relatively quickly and as long as the kiln is in operation there is a greater concentration of fluorine compounds per twenty-four hours being liberated in a defined area. Where large tonnages of ware are fired in tunnel kilns, such as, for example, sanitary ware, the results of the emission of fluorine compounds can be very clearly noticed in the etching of the glass windows near the kiln. In fact the concentration does reach a stage whereby standing at the kiln entrance one can feel the effect upon the eyes and nose. It also appears that these compounds do not altogether become part of the extraction system of the kiln for they can be noted inside the works even with a modern design of kiln. Undoubtedly the fluorine problem has been exaggerated by dealing with large tonnages of ware in a short time.

Move from Large Kilns

This maybe leads to the suggestion that the so-called fluorine menace is more likely to occur in the larger tunnel kiln handling large tonnages simultaneously rather than with the smaller type of kiln. In short, it seems fair to assume that the greater the quantity of ware fired in the heating zone of the kiln, the greater will be the concentration of fluorine compounds in the area itself. For other reasons, however, there has been a tendency to move away from very large tunnel kiln installations and to replace them by batteries of smaller-type kilns, and one would imagine that this would militate against high concentrations.

However, the problem has to be faced and it is an interminable instance of where progress in a circle has only the appearance of progress the disadvantage of the old-fashioned intermittent bottle-necked kiln was the dissipation over the countryside of smoke. The newer tunnel kilns have cut the smoke nuisance in the potteries down by 60 per cent. because of the use of refined fuels such as town's gas or electricity, but with this has

come the other problem which could hardly be anticipated in the heyday of tunnel kiln design, namely high fluorine compound concentration. The kiln designers have brought chemical engineering principles into the potteries and once they appreciate the problem there is no doubt that they will develop their chemical engineering principles to a stage whereby fluorine compounds can be scrubbed to manageable proportions. One hesitates to suggest that the fluorine effect is a major problem, and there is always a tendency for over-all deductions to be drawn from a particular instance. In smaller tunnel kilns the need for scrubbing is probably unnecessary, but with larger installations, handling a high tonnage of ware simultaneously in the hot zone of the kiln, then there is need for the problem to be overcome and in such installations which are themselves relatively expensive the building in of a scrubbing system becomes a proportionately less expensive operation.

It does seem clear, however, that when the emission of fluorine reaches a stage where it is etching glass, that in the interests of health—which means productivity or financial loss—as well as in the interests of economic factory maintenance, the problem should be tackled immediately and on the spot.

One does not want to create the idea that the fluorine problem is universally a menace wherever pottery of any kind is made—it seems to be localised in certain factories and the problem should be treated as a local one.

HIGH TEMPERATURE CERAMIC COATINGS

THE following is a summary of an article by J. V. Long entitled, "Ceramic Coatings," which appears in *Machine Design*, 1952, Vol. 24, May, pp. 122-6.

Describes the advantages of the Solaramic process for the protection of components working under high-temperature conditions, e.g., in gas turbines. The process was developed following extensive initial investigations on ceramic coatings carried out by the Bureau of Standards and the University of Illinois. (See *Nickel Bulletin*, 1952, Vol. 25, No. 2, p. 49.) It is currently being used to protect combustion chamber liners, nozzle boxes, jet tailcones and other gas-turbine parts, making possible, in some cases, considerable saving in critical alloy elements, by facilitating use of coated low-alloy materials in place of higher-alloy materials which require large percentages of strategic elements. Typical examples are given.

Comparative oxidation-test results, on ceramic-coated and on uncoated alloys, are cited in support of the advantages of this form of protection, and design considerations involved in construction of coated components are discussed. The physical properties of such coatings, and methods of applying ceramics to steels and alloys and processing the coated articles are reviewed. Work in progress on further development of Solaramic coatings, to an extended range of metallic materials, is briefly outlined.

(*The Nickel Bulletin.*)

BRITISH POTTERY MANAGERS' AND OFFICIALS' ASSOCIATION

THIS Association has now concluded arrangements for the 1952/53 series of lectures, which are as follows:

7.45 p.m. at the North Staffs Technical College.

1st September. "Milling and Materials." By Mr. A. Riley of The Furlong Mills Co. Ltd.

6th October. "Sifters, Glaze Cleaning and Magnetic Devices." By Mr. W. E. Box of Blending Machine Co. Ltd.

3rd November. "Glaze Manufacture and Glazing." By Mr. A. J. Dale, B.Sc. of Johnson Bros.

5th January, 1953. "Design and Decorating." By Mr. V. Skellern of Josiah Wedgwood & Sons Ltd.

2nd February. "Developments in Pottery Engineering." By Mr. John A. Johnson of Service (Engineers) Ltd.

2nd March. "Material Handling in the Pottery Industry." By Mr. D. J. H. Bridge of Fisher & Ludlow Ltd.

FACTORY VISITS

DURING the winter each year, the Applied Heat Co. Ltd., kiln manufacturers, Elecfurn Works, Watford, are pleased to welcome parties of up to thirty senior engineering students from technical colleges and research establishments, to their Watford works, where an interesting and extensive tour is arranged.

An invitation is extended to visitors from 1st September, 1952 to 31st May, 1953, on any weekday afternoon (Monday to Friday) and early application is advised.

THERMAL ANALYSIS

and its Application to the Identification of Ceramic Materials

(SPECIALLY CONTRIBUTED)

THERMAL analysis involves measuring the heat changes observed when materials undergo a physical or chemical change. It has been used for a long time for the determination of transition points, eutectic temperatures, etc. The application to clay minerals dates from 1887, when H. le Chatelier used the method in an attempt to classify the clays. Work of a similar nature was published by H. Wallach in 1913. Eight years later S. Satoh used the method to investigate certain kaolins, and in 1923 he published heating curves for a number of Japanese fireclays. He used a differential technique, but used quartz sand as a reference substance. H. S. Houldsworth and J. W. Cobb first used the differential technique as we know it today. The substance under test was heated with an inert substance, unlike the quartz sand used by Satoh. Initially this was platinum, but this was later changed to kaolin calcined to over 1,000° C., as being more comparable with the thermal capacity of the clay material under test. Evolutions or absorptions of heat were then indicated as differences in temperature between the inert material and the test substance.

This technique, with various improvements, is still used. In 1933, J. Orcel and S. Caillère used the method to study montmorillonite clays, and thereafter the method became increasingly appreciated, as shown by the increased use of it reported in published work on, for example, clays, laterites, and bauxites, talc, and pyrophyllite. F. H. Norton in 1939 described improved methods of carrying out thermal analysis, and showed that it could be

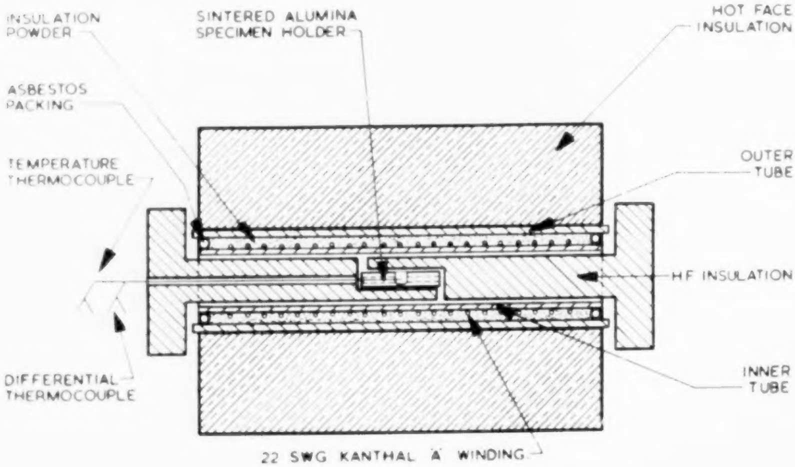


Fig. 1

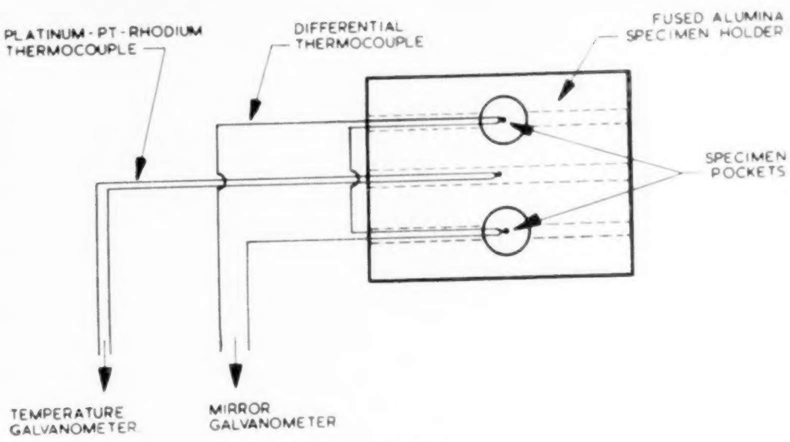


Fig. 2

used for the estimation of clay minerals. R. E. Grim and R. A. Rowland[3] have published differential thermal analysis curves for pure materials and also for synthetic mixtures of the commoner components of clays and shales, and have described how these can be used to indicate the composition and properties of a natural material. The use of the method as a routine control for raw material was also illustrated. In our own country the method has been applied, particularly to refractory clays, by Dr. R. W. Grimshaw and Prof. A. L. Roberts and co-workers.[4]

Apparatus

The apparatus required for qualitative thermal analysis is comparatively simple, and can be constructed with the usual laboratory facilities (Fig. 1). Some of the pieces, like the refractory block to hold the sample and the inert reference substance and the core (to the design of Dr. R. W. Grimshaw and Prof. A. L. Roberts), are now sold by the Thermal Syndicate, Wallsend. This refractory block is held in a cylindrical core which can be made by cutting a refractory insulating brick. This material is soft, and can be cut with a hacksaw blade, and drilled and ground with the usual materials. The core fits into a tube furnace, electrically heated. The furnace is made by winding the outside of a porcelain tube with either 80/20 nickel-chromium wire (20-22 s.w.g.) or with similar size Kanthal wire. The wound tube is then suitably insulated with asbestos or insulating brick. Since heating is not usually taken above 1,000° C., a base-metal couple can be used to indicate the furnace temperature.

The refractory block is usually made of fused alumina, and has two cavities, adjacent to each other, which hold the inert substance and the material under test (Fig. 2). About ½ gram of material is commonly used, and the size of the cavity is such that this amount about fills it. The thermocouples are located at the centres of the cavities, and are connected in opposition, so that when the two substances are at the same temperature, no current flows in the external circuit, which contains a sensitive galvanometer. The cold junction is provided by a thermos flask containing ice. For the temperature ranges required, the thermocouples are often of the chromel-alumel type. A heat change in the substance under test is indicated by a deflection in the galvanometer, and the thermal analysis curve is constructed by plotting the galvanometer reading against the temperature. To obtain reasonably sharp peaks on the curve, a fairly rapid rate of heating is desirable, and investigators recommend 10-20° C. per min., which means that the analysis can be completed in 1-1½ hr.

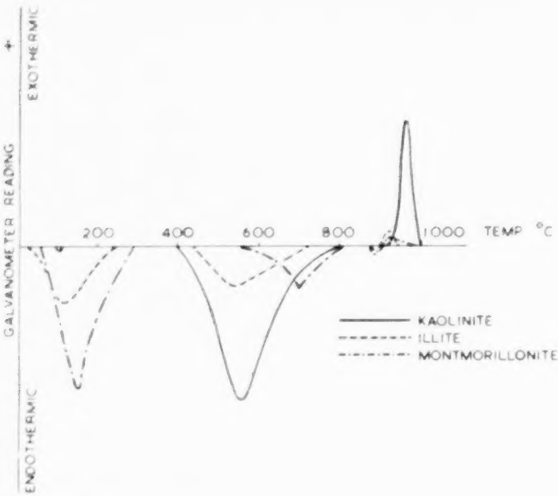


Fig. 3

Standardisation of Conditions Essential

For reproducible results it is necessary to standardise the conditions of the experiment. In this connection should be mentioned the packing density of the inert and the test substances, position of the thermocouples in the refractory block cavities, and the rate of heating. With regard to the first, it is usual to use a constant weight of the materials sufficient just to fill the cavities in the block. Control of the rate of heating can be done either manually, or with any of the numerous devices which are now available, depending on the money which can be spent, and the degree of accuracy required. Thus, one could use a motor-driven transformer to control the rate of heating, and a continuous recording device to indicate the furnace temperature.

Another device sometimes used for temperature recording is a signal lamp which is used in conjunction with a potentiometer, and can be set to flash for a short time every time the temperature rises 50° C., or any other suitable temperature interval. These flashes can be recorded on a strip of photographic paper in a drum camera driven by clockwork or by a synchronous motor. This provides a check on the rate of heating. Alternately, the time between flashes can be checked by an operative with a stop-watch. There are also pieces of apparatus now available which will make a continuous record of the thermal analysis curve. Where such refinements are not available, the rate of heating is often controlled by the use of variable resistances in the heating circuit.

Identification from Thermal Analysis Curves

Mineral types are identified by the positions of the peaks on the thermal analysis curve. As is well known, kaolin undergoes a decomposition at approximately 585° C., when dehydration of the molecule occurs. This is accompanied by an absorption of heat (endothermic effect). As E. B. Colegrave and G. R. Rigby[11] have pointed out, this first peak is spread between 450° and 750° C., and the peak position depends on the rate of heating (cf. also H. Insley and R. Ewell, loc. cit.) This emphasises again the need for standardised conditions noted above. There is also an exothermic peak (heat evolved) which commences in the region of 950° C. This coincides with the formation of crystalline γ-alumina.

F. H. Norton (loc. cit.) examined the differential thermal analysis curves for the kaolinite minerals, nacrite, dickite, kaolinite, anauxite, halloysite, and allophane. He concluded that the kaolinite minerals, as a class, could be

recognised by the exothermic peak at 980° C., and the individual members could be distinguished by the endothermic effects, which were distinct for each (with the exception of anauxite). Montmorillonite shows a less pronounced endothermic effect than kaolinite, and the peak is at a higher temperature (*circa* 700° C.). There is also a smaller exothermic effect, and at a lower temperature, and this is preceded by a small endothermic effect. Illite gives a smaller endothermic effect at a similar temperature to kaolinite. The exothermic effect is smaller and at a different temperature (Fig. 3). It should be mentioned that, in thermal analysis curves, absorbed water in the clay may make the portion below about 200° C. difficult to reproduce.

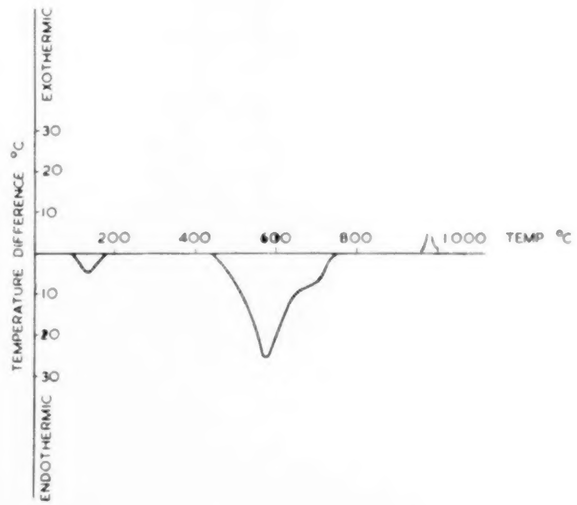
Applicable to Other Ceramic Materials

The various authors quoted above have also shown that the method can be used to differentiate other ceramic materials, like the hydrates of alumina, and to detect the presence of other materials which undergo heat changes when chemical reactions set in. Examples are hydrated iron oxide, pyrites, and certain carbonates like magnesite and dolomite (cf. also T. W. Howie and J. R. Lakin[11]). Apparatus for conducting thermal analysis in controlled atmospheres has been described by H. L. Saunders and V. Giedroyc.[12]

Evaluation of Mixtures.

Mixtures of ceramic materials can often be detected provided that there is sufficient of each to give a measurable heat change with the apparatus used. Grimshaw, Heaton and Roberts have published curves for mixtures of kaolinite and montmorillonite (Fig. 4) and have shown that with relatively simple apparatus it is possible to detect 5 per cent. of the latter. With more delicate gear this can be reduced to 2 per cent. They also give curves obtained on dolomite, showing endothermic peaks corresponding to the decomposition of magnesium and calcium carbonates. Numerous other examples are given in the literature quoted. The presence of carbon can give exothermic peaks often extending over a wide temperature range, and which may mask other peaks. For this reason it may be necessary to remove it with hydrogen peroxide or alkaline permanganate. It is not known whether this affects the clay minerals. Hygroscopic water gives endothermic peaks at 100° C. This effect can be removed by preliminary drying of the clay at 110° C. Most of the clay minerals can be detected by thermal analysis. Notable exceptions

Fig. 4



are the micas (except the hydrous types) and felspars. A method of resolving peaks which overlap is given in a later section (see double differential analysis).

Quantitative Determinations

It is obvious that the heat effect produced in a thermal analysis will depend on the amount of a particular component present. Consequently it should be possible from heat measurements to estimate the amount of that component. Absolute measurements of the heat would be difficult to make, and so it is usual to take the area under the characteristic peak as a measure of the heat evolved or absorbed. F. H. Norton has shown that while the position of the peak depends on the rate of heating, the area under it is not greatly affected by this. He has further shown that there is a direct linear relationship between the percentage of a particular mineral present in the sample and the area under the curve. This was shown by taking mixtures of bentonite and English china clay, and mixtures of gibbsite and kaolin. The areas under the characteristic peaks for each of the minerals concerned, i.e., kaolin (in the gibbsite mixture), gibbsite, bentonite, and kaolin (in the bentonite mixture) were found from the thermal analysis curves, and then plotted against the percentages of the minerals present in the mixtures as made up. A series of straight lines going through the origin were obtained. This means that, within the limits of experimental error, each of the minerals acts independently of the other. The average deviation from the straight line relationship was 2 per cent., and the maximum 5 per cent.

The method of determining the percentage of a mineral present in a sample, therefore, is to determine the area under the characteristic for the sample, and then to repeat the determination with a sample of the pure mineral. As an example, F. H. Norton found that the area under the 550° C. peak for diaspore was 0·61 sq. in. In the first-grade diaspore the area was 0·55 sq. in. The percentage diaspore in the first-grade sample was thus 0·55/0·61 multiplied by 100 or 90 per cent. Assuming the rest to be free silica and inert material, the ratio alumina to silica was calculated to be 7·4 against 6·63 obtained by chemical analysis. Closer agreement was obtained with a number of American clays and minerals as shown below:

Material	*Alumina/silica ratio from curve*	*Alumina/silica ratio chemical analysis*
Missouri semi-flint clay	0·61	0·55
Missouri flint clay	1·32	1·46
Missouri hard-flint clay	0·84	0·78
Missouri first-grade diaspore	7·4	6·63
Ditto second grade	1·41	1·82
Georgia bauxite	1·95	2·02

Double Differential Thermal Analysis

In using thermal analysis on a quantitative basis there are certain difficulties, some of which have already been touched upon. Thus two peaks may interfere with each other, and it is then necessary to attempt to resolve the curve into the individual peaks. For this the technique called double differential analysis is sometimes employed. In this method the differential analysis curve is first obtained in the usual way. From this it is often possible to identify one of the minerals present, and its approximate amount in the mixture. An equal amount of this mineral is then added to the inert reference substance, and the experiment repeated. Provided that the amount of the substance has been correctly estimated, it produces in the inert substance a heat effect equal to that in the sample under test, and, as the thermocouples are in opposition, this means that the effect of that one substance is eliminated, leaving the peak and curve for the other.

Grimshaw, Heaton and Roberts, in the paper already referred to, give an example of how kaolinite and montmorillonite may interfere in a thermal analysis and of how the kaolinite peak was suppressed by the addition of 40 per cent. of kaolinite to the inert substance.

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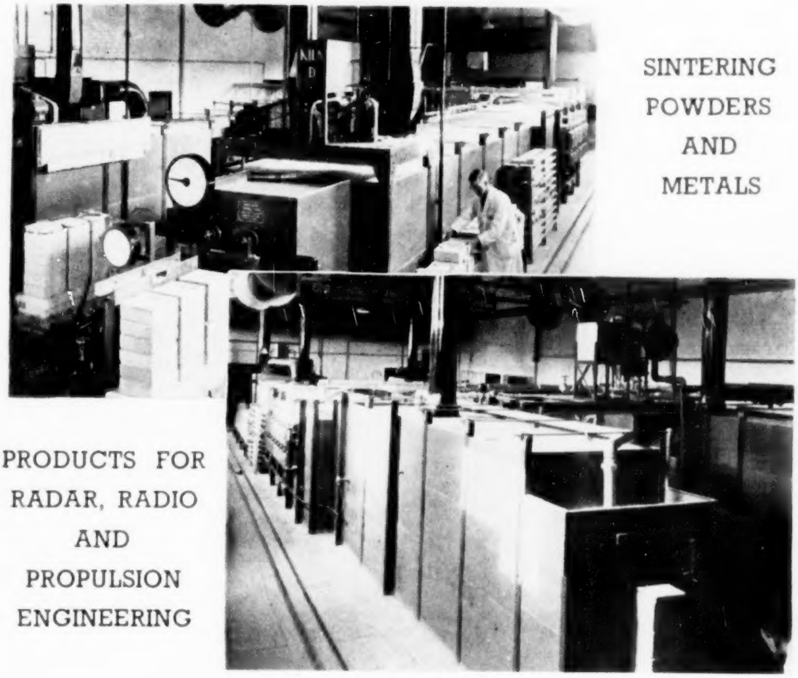

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The same authors, and also R. E. Grim, have pointed out that another difficulty arises from the drift in the base line from which the areas under the peaks are measured. It is often found that the base line, which should remain horizontal, shows a slight inclination, due to temperature differences between the inert and the test substance other than the heat changes in the test material. This drift is caused by unsymmetrical location of the sample containers in the block, and of the latter in the furnace. Another cause is local overheating, due to a bad fit between the portions of the block. These are constructional features, which can be remedied. Apart from this there is the possibility that the heat may penetrate the inert and the test samples at different rates, and that this may be aggravated by changes which take place in the mineral as the thermal analysis proceeds. For this reason it is desirable to use as reference inert material something of a similar nature to the material being tested. Nowadays calcined alumina or china clay are used.

A way of correcting for this drift has been given by Grimshaw, Heaton and Roberts, taking a curve obtained with kaolinite as an example. After the first endothermic peak it was found that the drift was regular, although the base line was slightly inclined to the horizontal. This base line was therefore produced backwards to cut the curve at the point where that endothermic reaction began, and this was adopted as the base line. This process is admitted to be arbitrary, but insofar as it improved the reproducibility of the results, appeared to be justifiable.

Effect of Particle Size

The particle size also has an influence on the heating curve, the finer particles giving up heat more rapidly than the coarser fraction. F. H. Norton demonstrated this with an American plastic kaolin which was fractionated with the aid of a centrifuge. While the beginning of the endothermic reaction and the peak temperature remained the same, the curve returned to the zero line more rapidly with the finer fractions as shown by the following results:

Grain size (μ)	*End of Endothermic reaction (°C.)*	*Endothermic Max. (°C.)*
1.0 to 4.4	670	600
0.5 to 1.0	650	605
0.25 to 0.5	630	605
0.1 to 0.25	615	600
Less than 0.1	610	600

With the very fine fractions there were abnormalities in the exothermic part of the curve which were difficult to explain. This again emphasises the need for standardising as many of the conditions as possible in thermal analysis.

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Mr. E. G. Pickering. Mr. E. G. Pickering has been appointed joint managing director of Johnson Matthey and Co. Ltd., assayers to the Bank of England and refiners of precious metals. He will fill a vacancy on the board caused by the resignation of Mr. T. Girtin.

(*Continued from* CERAMICS, *July*, 1952)

The Planning and Reconstruction of Pottery Factories

By

M. UPRIGHT, A.R.I.B.A., A.M.T.P.I.

THE selection of the type of tunnel kilns to be used is the province of a competent kiln specialist conversant with all types of tunnel kiln construction. Even he will only be able to tender advice after thoroughly acquainting himself with the production and manufacturing problems of the ware to be produced.

The problems of each manufacturer are so varied that every kiln must be designed specially to meet the production and other requirements of the particular installation. The length of the tunnels varies enormously and of necessity the architect must know the lengths of the kiln at a very early stage in the preparation of his plans; for these considerably affect the planning of the various departments and the whole pottery.

New Methods

Throughout its history the pottery industry has been cautious in adopting new methods. In recent years, however, increasing competition has inclined the industry to consider new methods and appliances, which have for their aim improvement and speeding-up of production. Among these are "conveyors." Many of the conveyor systems now in use are found in old potteries where they have proved an unqualified boon. The original inconvenient arrangements have been vastly improved, resulting in lower labour costs, increased production and a reduction of breakages and fatigue caused by excessive carrying.

It would be a mistake to consider the use of conveyors in new factories as mechanical devices for overcoming flaws in the flow of production; this should exist without such expedients which for the purpose of design should be considered solely as parts of the machinery to be housed in the structure. The use of trucks to receive the ware at different stages of production is now considered by many to be a better arrangement than the installation of conveyors. Their use where upper floors occur necessitates the installation of lifts, the location of which must again be determined in accordance with the flow of production of the factory.

Heating and Ventilation

The provisions made for adequate heating and ventilation alike are of the utmost importance. The requirements of the law in respect to these matters is both general and profound and can be summed up in the statement: "Adequate facilities should be provided to secure a pure, fresh and comfortable atmosphere." In the majority of buildings it is usual to provide one system of heating throughout. In potteries it will more often be found both serviceable and economical to warm various portions of the works by different means. Waste heat from the kilns in the form of hot air may be obtainable, while surplus steam may be available for space heating in addition to the supply to the drying stoves, etc. Such supplies, particularly from the kilns, are necessarily limited and their extent can only be determined by consideration of the actual installation. It may be necessary, while making full use of these sources, to install a further

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Mr. Malcolm Upright, of F. V. Hulme and Upright, Chartered Architects and Town Planning Consultants, addressed a meeting organised by the Ministry of Works and the North Staffordshire Architectural Association, on the 19th March, 1952, at the North Staffordshire Technical College.

system of low-pressure heating or an extension to a system used for production purposes for general heating. The method of distribution of the heat which is becoming increasingly popular is the unit system. These units are fixed to the ceiling or roof members at suitable intervals, air being forced through the radiator and directed down to the floor, and thus ensuring an efficient air movement. Although extensive combined systems of heating and ventilation are not in common use, this system of heating may be combined efficiently with the ventilation of the factory — the unit heater being connected to a duct having openings to the outside and to the workshop, each opening being controlled by damper, and if necessary a filter screen (Fig. 7C).

Permanent Ventilation

Apart from the provision of opening lights in roofs and windows to be used at the discretion of the operatives, some permanent means of ventilation should be provided. Numerous types of suitable roof ventilators are available for this purpose. Their comparative merits are outside the scope of this lecture. As a general rule, roof ventilators are suitably placed at approximately 30 ft. centres while over tunnel kilns they should be placed at centres not exceeding 20 ft., as in some instances a continuous louvred ventilator running the full length of the ridge above kiln positions is desirable. Natural ventilation cannot possibly be efficient without openings of suitable and proper arrangement for the inflow and outflow of the air. In some cases, efficient ventilation, particularly in winter, cannot be obtained and it is necessary in these circumstances to engage the services of a ventilating engineer to design a system of mechanical ventilation.

Taking the year round, about four-fifths of normal working occurs during the hours of daylight. Efficient natural illumination is, therefore, of cardinal importance. It is not merely a question of economy in cost, since bad light is expensive, producing inferior workmanship and excessive breakages. Theoretically, there cannot be too much light, but in practice problems arise such as the reduction of heat in summer and the conservation of heat in winter and these matters require careful attention.

The accepted practice in Europe of using the north light roof truss affords an easy solution although disadvantages are incidental to this system since large spans of 50 or 60 ft. are not economical and there is often an over-proportion of glass to floor area. Cleaning the glass is also difficult as the only access is along the valley gutters which in themselves

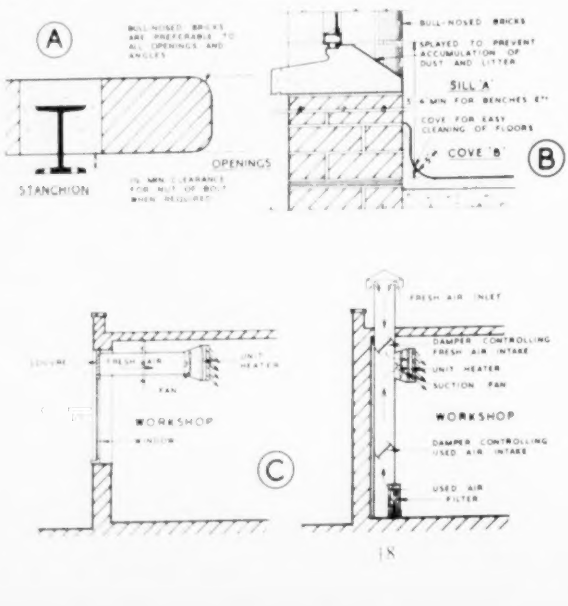

Fig. 7. A and B show typical details of construction, and C alternative methods of heating and ventilating with a unit heater

are often a source of minor troubles.

The principle to be adopted in the use of this roof should be to provide the maximum of reflection from the underside of the south slope with the minimum of glass in the north light. Some authorities on factory building consider the north light truss to be obsolete, since it fails to provide facilities for good ventilation in all weathers and it is expensive to make both wind- and dust-proof. They prefer the east-to-west type of truss which they claim gives better ventilation in all weathers and better light for the workers when the direction and intensity of light varies.

Fig. 8 shows the various types of roof trusses I have mentioned. The first figure illustrates the familiar north light truss and the other various types of trusses adopting the east-to-west principle. Type B incorporates the system of clerestory lighting. The vertical windows are readily cleaned from the flat roofs and are easy to arrange and manipulate as opening lights, as compared with the difficulty experienced with the north light truss.

Type C is the ordinary equal-sided truss with a portion of each slope glazed. It has many of the disadvantages found in the north light truss, the glazing not being readily accessible for cleaning or easy to open for ventilation. Large spans are not economical though some factories have been built making use of this truss and large lattice girders under the ridge to eliminate an excessive number of stanchions.

Types D and E are adaptations of the north light truss to east-to-west lighting. The windows are accessible from the adjoining roofs and the difficulty of negotiating awkward gutters when cleaning and repairing is avoided. Type E has a lattice girder which eliminates the centre row of stanchions shown in Type D and clerestory lighting is also introduced.

The admission of the direct rays of the sun is not now considered to be a disadvantage, but when using east-to-west light, care should be taken not to render portions of the works uninhabitable during sunny weather. The use of prismatic or ribbed glass for diffusing the rays will avoid this.

The efficiency of the lighting of multi-storeyed factories is obviously dependent on the height of the floors and the width of the building. A compromise between the one floor layout is shown in Type F. The bays should be as wide as possible and the height of the upper storey at a minimum so that the maximum of direct light may be provided at ground floor level. With the careful disposition of the processes and plant on the ground floor this arrangement may usefully be adopted where the requirements of the manufacturer and the character of the site are such that the single-floor layout is impracticable.

The efficiency of any factory depends primarily on its capacity for being easily worked and managed with a minimum of labour costs and overhead expenses. To achieve this, it is not only essential to have a well-planned and organised works, but also a suitable environment for the operatives, in which their best workmanship may be produced. It should not be forgotten that apart from the hours of sleep the greater part of the employees working day is spent in the factory.

The structure, like the organisation should not be designed with such mechanical precision that the very employees are in danger of being transformed into robots. Workshops should be permeated with that amiable atmosphere that causes workpeople to feel they are surrounded with the best possible facilities to be themselves efficient and thus produce their best work. This "atmosphere" can often be created in existing factories by the careful consideration of the interior decoration of the workshops. The judicious use of colour throughout the factory creates a friendly atmosphere and in new factories there is no reason why this should not be done at very little additional expenditure.

Pottery manufacturers do not gain an adequate compensatory return by spending excessive sums on the façades of their buildings as an advertising proposition. To secure a well-designed pottery, possessing real architectural merit, need not be expensive. The intervening space between road and building now required almost invariably by a prescribed building line should be planted with shrubs or laid out in lawns. This adds to the appear-

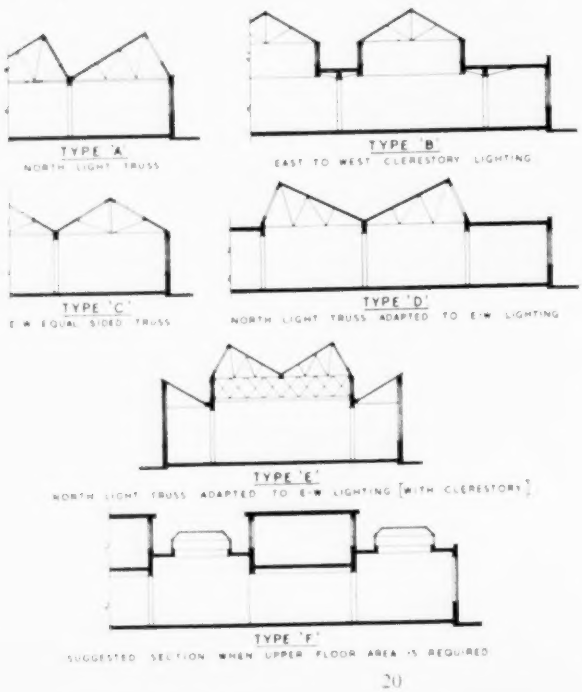

Fig. 8. Types of roofing for potteries

ance and environment of the building and tends to soften its industrial and utilitarian aspect.

The tendency amongst designers to give an atmosphere of solidity to the main elevations of industrial buildings and to treat the remaining portions on strictly utilitarian lines has had its repercussions on recent buildings for the pottery industry.

The usual interpretation of this idea has been to design the main façade, of which the offices in new factories should form part, with the flat roof and to develop the remaining works with the north light or other roof truss. Such a general scheme may usefully be considered by architects of potteries, although it is well to remember that all stereotyped and preconceived methods of design are rightly suspect. The intelligent use of various alternative materials and methods of construction together with the careful designing of the fenestration will obviate this possibility arising. In every case of pottery building, so much depends on individual and particular factors such as the character of the site, the financial status of the manufacturer, the quality and quantity standards of production, that it is impossible to lay down any hard and fast rules to regulate the treatment of pottery buildings; nor is it desirable since the finest examples of design in any sphere and particularly in architecture are only achieved in so far as the creative genius of the designer grapples successfully with the special problems and needs of a particular subject or building.

Form of Construction

Modern potteries may be built in the lightest forms of factory construction since the majority of heavy machinery required in the industry is to be found in the sliphouse and this is necessarily accommodated on the ground floor. In a number of factories, the tunnel kilns have been sited on upper floor levels to meet the particular requirements of site and manufacturing necessity. This arrangement can, I think, be considered an expedient in difficult circumstances rather than an acceptable form of layout for general application to factory design, since a costly structure of adequate strength is

necessary to support the kilns in such a position.

The form of construction most usually adopted has been the steel frame with brick infilling walls and it is doubtful whether its popularity will decline in favour of the ferro-concrete construction, which has more recently been introduced into this district, possibly for the sole reason of the necessity to observe the greatest economy in the use of structural steel.

The steel-framed and brick structure lends itself more readily to alteration and extension, it is cheaper to erect and with forethought the structure may be utilised to fix brackets for carrying gear and conveyors, etc., where these are required, without the use of unsightly star plates which are so often the disfigurement of ferro-concrete factory structures.

Roof Strength

As bricks have withstood the local atmosphere and retained their texture and colour much better than other materials, and since in addition they are generically a form of pottery, closely allied both by geographical proximity and process with the making of pottery, their use in pottery building is logically congruous and has been proved æsthetically sound. The various types of roof principles have been considered earlier, their strength should be so calculated that they are capable of receiving a point load of at least 10 cwt. since they are often used for carrying or lifting purposes. With regard to portions of the factory which may be roofed in by flat roofs, these, if single storey, and obviously capable of being raised should be calculated on the basis of a superimposed floor load of at least 200 lb. since it will be found in the course of time that invariably the manufacturer will look upon them as potential ready-made floors of further extensions.

The height of single-storey buildings should be at least 11 ft. 6 in. to the underside of tie beams and in the case of buildings with upper floors, a minimum of 12 ft. 6 in. from floor to floor is advisable. These heights are normally suitable for all making departments and warehouses, but additional height may be required over tunnel kilns for extract trunkings and adequate ventilation.

Floor Finishes

The selection of floor finishes throughout the factory usually resolves itself into a question of cost on complying with the standards laid down in the pottery (Health and Welfare) Special Regulations. It is of paramount importance these regulations should be observed in the effort to combat Silicosis. The fact that there is such an advance in cost for suitable floor finishes above the cost of a granolithic floor renders its use in sliphouses, potters' shops and dipping houses almost universal, and it is very suitable when treated with silicate of soda or other hardening compound to prevent dust. It is a mistake to believe that this type of floor is cold to the feet, although it has to be admitted that its cold appearance possibly has this psychological effect. The quality of the workmanship in laying granolithic floors is of the utmost importance and this, together with correctly chosen aggregate and proper mixing will ensure a good floor finish.

It is unfortunately true that there are few floor finishes available at reasonable cost to make them an economic proposition for use in pottery factories. The Natural Asphalt Mineowners have produced various grades of asphaltic compounds which will withstand abrasion and fluctuation in temperature and their cost is warranted in decorating shops and warehouses. Magnosite composition floors have been used considerably, but their hardness and susceptibility to crack on suspended floors has, to some extent, brought them into disfavour, although they are very suitable for use on solid floors at ground-floor level. There are, of course, many other types of finishes admirably suitable, but their cost invariably prohibits their use. Before leaving the subject of floors, a refinement which is well worth while is to provide coves, of the floor material used, at the junction of wall and floor surfaces—this facilitates cleaning and prevents the accumulation of dust in the angles and crevices.

The internal division between the various departments of the factory

should be as far as possible independent of roofs and floors, so that they may be altered at any time without interfering with the structural stability of the building. They may be constructed in brick or patent blocks, or wood and patent steel partitions may also be used, and these should be so detailed and standardised that they have a good proportion of glazing and may be easily removed and bolted into new positions. Walls of sliphouses and dipping houses are preferably tiled or constructed in glazed bricks. It is an advantage to use bull-nosed bricks to all external angles of brickwork throughout the factory, as these provide a more pleasing effect than the sharp arris of the ordinary common brick (Fig. 7A).

The windows may be of galvanized steel or wood, the former being preferable since they give a much greater proportion of glass area to frame. They should be as large as possible with at least 5 sq. ft. of opening light for every 100 sq. ft. of floor area. The heads of window openings should be constructed within a foot of the ceiling or tie beams. Sills should not be less than 3 ft. 6 in. high from the floor so that benches may be placed beneath without interfering with the window openings. The sills of workshops should be splayed to prevent the settling of dust and the accumulation of litter (Fig. 7B).

This lecture on the planning and reconstruction of potteries has necessarily required an investigation over a wide field, and in the time at my disposal, it has only been possible to set out the results of that survey in a very brief and summarised form. Nevertheless, I trust enough has been said to prove that there is real ground for my own conviction that in the not too distant future, great and beneficient changes are imminent in individual potteries and pottery towns.

Mr. E. Shaw

Mr. Eric Shaw, sales director of the Oughtibridge Silica Firebrick Co. Ltd., and director of Monolithic Dolomite Ltd., Steetley, has been elected a member of the Council of the Refractories Association of Great Britain.

NEW AMERICAN DEVELOPMENTS

Drainage Pipes — Sorting Ceramic Ware — Electric Thickness Gauge — Packing Costs

Drainage with Ceramic Pipe

A FARMER in the United States has found it so advantageous to instal drains made of ceramic pipe in his fields that he has embarked on a 10-year programme, thus gradually installing a complete soil-drainage system. The partially completed system has already resulted in greater efficiency, and more and better crops. He can now easily haul and spread manure daily, work when the ground would otherwise be too muddy, and cultivate at the proper time.

This project is being carried out on a dairy farm in Lake County, Ohio. In a typical season, the farmer lays 11,000 ft. of ceramic drainage pipe, 4 in. dia. (Bosco Perforated Drain Tile, Bowerston Shale Co., Bowerston, Ohio), on a 20-acre area in ten working days with the aid of a farm drainage contractor and three helpers. His equipment includes a Buckeye No. 1 Ditcher (Gar Wood Industries, Inc., Tulsa, Oklahoma) and a Farmall H. and M. Tractor (International Harvester Co., Chicago, Illinois).

Trenches are dug not less than 30 in. deep on a grade sloping from 3 to 12 per cent. and spaced 70 ft. apart to allow for additional drains as they become necessary in the future. The water drains into 6-and 8 in. mains, from there into a large gulley, and thence into the lake. The pipe is placed into the ditch behind the Ditcher, between two large shields which prevent dirt from falling into the ditch until the tile is laid. Then a tractor with a bulldozer blade pushes the dirt back into the ditch. When the soil is too hard to permit fast drainage, gravel, granulated slag, or cinders, are placed around the tile before filling in the trench. In areas where the soil is often muddy, such a plan can provide an appreciable increase in productivity.

(*Brick and Clay Record*, March, 1952.)

"Step-Down" Method of Sorting Ceramic Ware

The physical labour of sorting brick can be cut to a minimum by using a labour-saving device such as the step-down process employed by the Hanley Co., Summerville, Pennsylvania.

Several classification tracks are located at the discharge end of the three kilns. The many kinds of ware manufactured are assembled there before sorting. The cars, propelled by Hanna air cylinders (Hanna Engineering Works, Chicago, Illinois), move forward on two tracks at regular intervals, as required by the sorters. The sorters themselves stand on benches of varying height, the highest being near the sorting area or track. Thus, at each bench, the sorter is at the correct height to remove his own particular layers of ware, the bench heights becoming progressively lower as the cars unload. The sorted ware is placed in trays which are removed by crane or from lift trucks. A conveyor belt, situated between the workers, who operate on both side of the car, carries scrapped ware to a jaw-type crusher. The crushed material is sold locally for repairing roads, etc., and brings in a worthwhile profit.

(*Brick and Clay Record*, April, 1952.)

Electric Thickness Gauge for Ceramics Coatings

A recently developed gauge, stated to be accurate to 0.0005 in., makes it possible for an operator to determine the thickness of ceramic or other coating material on either curved or flat non-magnetic surfaces, without marring the coated surface in any way. The instrument was built at Ryan Aeronautical Co., San Diego, California, from designs prepared by the United States National Bureau of Standards, Washington. It comprises a plastic test head and a plastic rod attached to a dial indicator gauge. An electromagnetic probe coil and an inductance balance indicator, utilising a galvanometer, are embedded in the plastic head. The inductance balance unit incorporates an impedance bridge, which can be adjusted by potentiometers to bring the galvanometer to zero reading when electrical balance is attained. The slender plastic rod, which protrudes through the probe coil, is free to move axially. The dial indicator gauge measures any displacement of the rod.

In operation, the probe coil is placed against an uncoated metal surface, with the plastic feeler rod in contact with the metal, in order to calibrate the gauge. The dial indicator is set to zero and the current is switched on. The impedance bridge is adjusted until the galvanometer also reads zero. Next, the calibrated coil is transferred to the surface of the coated part, and the distance is adjusted until the galvanometer again reads zero, at which point the sensitive plastic feeler rod is displaced by an amount exactly equal to the thickness of the coating. The amount of displacement is shown on the dial indicator gauge.

(*Steel*, 31st March, 1952.)

Wirebound Crate Cuts Packing Costs

The redesign of a shipping crate with wire reinforcement, so that a single type of prefabricated crate can be used for refractories, bricks, and tiles of various shapes and sizes, has reduced packing costs more than 25 per cent. in a brick factory in the U.S. In addition, the redesigned crate is so much easier to use that men in the packing room have tripled their production.

Formerly, even when very heavy crates were used—accommodating 600 lb. or more—there were frequent complaints of damaged shipments. Now, the new crate, which weighs only 32 lb., has been in use for 18 months and, although being shipped all over the world, has not caused a single complaint. In addition, its light weight reduces shipping costs, and greater resiliency and shock absorbent qualities are obtained.

A sectional wooden mat, reinforced at the sides and braced around the hinged ends with steel wires, comprises the prefabricated container. The packer nails the ends of the crate in place after he bends the sections to form an oblong cubicle, leaving the hinged top section open. Wooden skids under the bottom section identify the bottom of the wire-bound crate.

Testing Equipment. Research Equipment (London) Ltd., have just issued a folder illustrating various items of testing equipment which they manufacture for the paint and allied trades, amongst which are humidity cabinets, salt spray cabinets, hardness rockers, fineness of grind gauges, and film applicators. They will shortly be opening a small showroom at their offices, 64 Wellington Road, Hampton Hill, Middlesex, where a selection of research equipment can be viewed.

(Continued from "Ceramics," July, 1952)

PROBLEMS IN BUYING REFRACTORIES

By

D. WRAGG, M.P.O.A.

Purchasing Director, Thomas Firth & John Brown Ltd.

IN the case of refractories I buy, a great deal of inspection is carried out by the Refractory Section of our Research Laboratories. It is a daily task.

Although I am discussing the question as it concerns the steel industry the matter is one which raises it head at meetings of the Purchasing Officers' Association throughout the country, representing about 3,000 Purchasing Officers in Great Britain, and there is no doubt a need in all industries for specifications by which refractory products may be judged acceptable or unacceptable. It is obvious that in refractory bricks, produced from materials by processes admitting frequent opportunity for variability, the results of tests of any one brick cannot be used to determine whether a truck load should be approved or rejected. The only effective control is by statistical treatment of many numbers of results, each result for a particular property being derived from a sample drawn at random from the truck.

Now obviously a manufacturer can effect a better control than his customer because his samples are obtained from his entire production. I understand that few brickmakers appear to have a fully reliable and perpetual system of quality control, although it seems reasonable to expect that the producer should be able to give complete and satisfactory evidence of the claims made for the product, and that deliveries should conform with these claims.

This means that consumers must do more routine testing than should otherwise be necessary and prepare histograms applicable to this study. Economic considerations in a steel works often compel the formulation of conclusions from a smaller number of samples than is considered necessary for providing the necessary data, a circumstance which might be largely eliminated if quality control was practised by manufacturers generally.

Variation in Quality

A study of these histograms of the various properties of firebricks and silicas reveals wide ranges of variations indicating a general need for improvements of uniformity which is only likely to be attained if manufacturers will adopt systems of quality control in their works.

The Table I, page 28, shows the mean porosity and refractoriness of four brands of firebrick and a "scatter index" typical of each brand. This scatter index as you know is merely an expression of the range as a percentage of the mean.

From these figures it is clear that properties endowed by nature are less variable than those created by man. The refractoriness of firebricks varies little compared with the porosity of the same bricks.

Bricks B, C and D are all made by the same type of machine which differs from that used for brick A. It is, therefore, perhaps not surprising

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An address at a meeting of the Refractories Group of the Sheffield Metallurgical Association, 25th March, 1952. Reprinted by permission of the "Purchasing Journal," published by the Purchasing Officers' Association.

that the variability of porosity is similar for B, C and D and different for A, though always much greater than the variation of refractoriness. Hence it appears that in these respects brickmaking operations impair rather than enhance uniformity.

A similar sort of answer may be found by studying the results of tests of silica bricks. In this case, all the properties have been influenced by manufacturing methods, but some (e.g., refractoriness) prove less susceptible to influence than others (e.g., porosity, lime content, etc.). Table 2 on page 28, illustrates these points for four silica bricks.

The greatest variability is seen to reside in those factors which today are believed to influence performance in steelmaking furnaces to the greatest extent, i.e., porosity (bulk density) and alumina and lime contents.

The figures used in the tables relate entirely to well-known products. Size variation of bricks has been purposely omitted from this discussion, though certain applications to steel furnaces might well justify its inclusion. Whether this is included or not, the variations which have been indicated surely suggest that account of the variability of such products as refractory bricks will have to be taken, in drawing up specifications which are now long overdue. Without specifications, what is to prevent the scatter index increasing so that the "mean" value has less meaning than at present?

This system of manufacturers control is essential before any user specification can be formulated without the risk of:

(a) Making specifications too loose,
(b) Curtailing supplies through inability of the makers to meet the specification.

This establishment of reliable specifications is therefore hampered mainly by two factors:

(1) The inadequacy of quality control by brickmakers generally,
(2) The different "levels," characteristics of different products, offered for the same purpose.

Is not the time overdue for a general appreciation by brickmakers of their responsibility to customers in

TABLE 1. FIREBRICKS.

Brand	Porosity Mean (per cent.)	Porosity Scatter Index (per cent.)	Refractoriness Mean (°C.)	Refractoriness Scatter Index (per cent.)
A.	25·6	31	1,626	9·6
B.	22·1	44	1,677	4·1
C.	21·3	42	1,698	3·6
D.	26·1	44	1,674	6·5

regard to the compiling of evidence of satisfactory average quality and uniformity, by properly conducted technical testing of their products? The customer would satisfy himself that such data was acceptable and reliable, and would then need to do less testing than at present unless the stringency of his requirements was increased. In this way the manufacturer would merely be performing a service to customers hitherto avoided.

At the present time the only possible course is to adopt different specifications for similar products from different makers, which to say the least is unjust to makers already controlling their products, unless, of course, a suitable price grading is arranged for uncontrolled bricks.

I understand that in the U.S.A. it is the usual practice for producers to make use of strict quality control and tests of their finished products. Ordinarily, this would not be furnished to the individual buyer, but would be the producer's own assurance that his product is made to quality standards for a particular grade, since there is an implied warranty of quality and characteristics for every recognised grade. Practice as to testing in the U.S.A. by the purchaser varies so widely that no generalisation can be made. The large, well-organised company with testing facilities will test representative samples for their conformance to quality standards. The smaller company would generally rely on the implied warranty or look to the contractor making a test to assure that the product is of the proper quality.

Buyer's Storage Problems

The seller's market referred to earlier has also had its effect on the storage accommodation required at the buyer's works. The ideal arrangement from the buyer's viewpoint would be to carry the minimum stock possible, say a fortnight's requirements, but the supply position will not permit this. Today, the buyer knows from long, and often painful experience, that he must be safeguarded against a hold-up in production or delivery, bearing in mind that refractories are the life-blood of the steel-making programme, and so he endeavours at all times to have a stock by him, whereas if deliveries were assured, as and when required, only the minimum stocking space would be required.

We all know stocking space in a steel works is strictly limited and extremely costly. It has become impossible to obtain additional space, and a million bricks occupy a great deal of space. The floorage required for this purpose in my own works is nearly half-an-acre of very valuable

TABLE 2. SILICA BRICKS.

Brand	Porosity Mean (per cent.)	Porosity Scatter Index (per cent.)	Refractoriness Mean (°C.)	Refractoriness Scatter Index (per cent.)	Alumina Mean (per cent.)	Alumina Scatter Index (per cent.)	Lime Mean (per cent.)	Lime Scatter Index (per cent.)
F	29·5	35	1,708	2·34	0·85	50	1·89	37
G.	26·9	44	1,718	1·16	0·86	40	1·63	25
I	29·2	25	1,708	0·86	0·95	24	1·87	40
J	25·4	34	1,712	1·75	0·88	47	1·50	53

ground, whereas similar facilities at the brick works, usually in the country, are relatively easy and much less costly.

Now it seems to me that this is a feature refractory firms should look upon with a great deal of real sympathy, bearing in mind that it is their responsibility to stock bricks for use as and when required by the steel makers. It should not be the steel makers job to carry large and costly stocks because of the uncertainty in the supply position.

From all viewpoints it is most uneconomical.

I know this would mean a greater awareness on the part of the refractory makers as to the customer's requirements a long time ahead, and possibly more plant to provide for quicker deliveries. The refractory maker might well point to the fact that refractories are not the only materials which have to be stocked at steel works, but I would say that no other material, apart from steelmaking materials, presents a problem of this magnitude.

I feel it should be borne in mind that the steel maker is a customer of such paramount importance as to warrant very special consideration of every feature of his requirements. The iron and steel trades consume yearly over 800,000 tons of refractories, i.e., half the total output. It is an assured market, and the United Kingdom is well endowed with the necessary raw materials to supply the market.

The Customer

Refractories are so closely associated with steel, the one dependent on the other, as to suggest that it is really practicable for market research to be conducted so as to evaluate the buyer's need ahead for existing types of refractories, as well as new ones. I suggest this as one means of more intelligently providing for the future market, and thus placing refractory firms in a happier position to supply types or qualities as required and preventing, or at least substantially minimising the periodical production excesses or shortages with distinct economical advantages to both parties.

At the present time the contact between the salesman and the purchasing officer is irregular and at such long intervals as to lose its real purpose. Seldom, these days do I see a representative of a refractory firm. There are no regular or systematic enquiries concerning present or future demands. In the case of one important supplier firm I have only seen one representative in the last 12 years, and I am certain that closer and intelligent liaison would do a great deal to iron-out the supply position, both short and long term. No one is more aware than I, that refractory business today is easy to come by, at the time, whilst it is not necessary to solicit orders, this question of service should not be lost sight of. There is still a great deal a representative can do and I am equally sure there will be much for him to explore in the difficult trading years which are bound to follow the present bewildering state of trade, and in this respect I would venture the following remarks:

- A customer is the most important person ever.
- A customer is not dependent on suppliers, they are dependent on him.
- A customer is not an interruption of suppliers' work; he is the purpose of it and he is doing them a favour by giving them the opportunity to work for him.
- A customer is not a cold statistic, he is a flesh-and-blood human being, with feelings and emotions, biases and prejudices.
- A customer is not someone with whom to argue or match wits. Nobody should ever win an argument with a customer.
- A customer is a person who brings his wants; it is the supplier's job to handle them profitably to both parties.

That is what a customer is in any type of business. Some people seem to have forgotten a few of these basic truths in recent years, but it is high time to remember them again. To-morrow may be too late.

Wild-Barfield Electric Furnaces Ltd.—Wild-Barfield Electric Furnaces Ltd., in conjunction with their associates, G. W. B. Electric Furnaces Ltd., have established an office in Scotland which will be under the control of their existing representative, Mr. D. McDermott. The office is situated at 131, West Regent Street, Glasgow, C.2. (Tel. No.: Douglas 8839.)

CARBLOX LIMITED—NEW TUNNEL KILN

THE lighting-up recently of the new tunnel kiln at the Loxley Works of Carblox Ltd., represented the culminating point of an expansion scheme that has been taking place over the last two years.

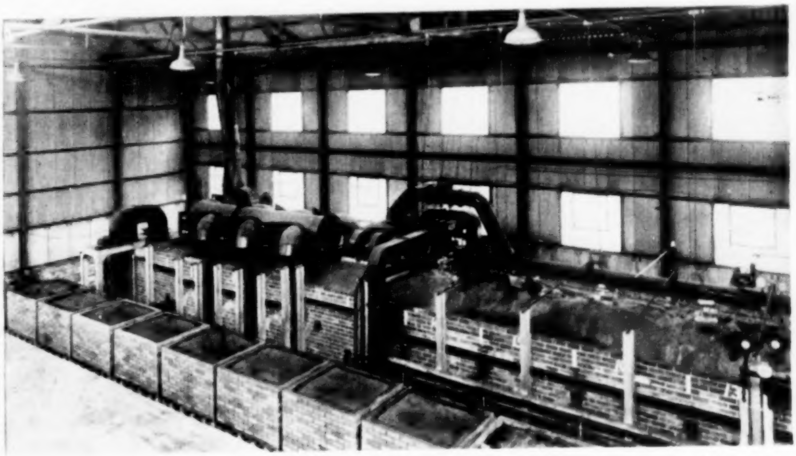
A few short years ago, two companies associated in order to study and manufacture carbon refractories, at the request of the iron-making industry. These two companies were Thomas Marshall and Co. (Loxley) Ltd., of Loxley, Sheffield, and the Morgan Crucible Co. Ltd., of London, and the company so formed was Carblox Ltd., of Storrs Bridge, Sheffield. Together they investigated, developed and produced Carblox refractories.

Within a very short space of time, it became apparent that the demand for this type of refractory was far outstripping the production capacity of the original pilot plant. With improved manufacturing methods and technique it was possible to increase output. Thus, within three years of commencing full-scale manufacture, Carblox had more than doubled their output and have continued to increase their production every year. Even these efforts did not solve the ever-growing problem of supply and demand, and it was obvious that new plant would have to be erected.

The Board of Carblox Ltd., put in hand a programme of expansion involving the erection of new buildings and plant ultimately to quadruple the 1950 output. The starting-up of the tunnel kiln, already mentioned, represented the end of this second phase of Carblox history—a phase which it is anticipated will meet all the demands of the iron and chemical industries for many years to come.

The new tunnel kiln is worthy of note, and the following details will be of interest. The overall dimensions are 133 ft. long and 18 ft. wide, 12 ft. high. It has a capacity of twenty-three cars which are 5 ft. 6 in. long, 5 ft. 3 in. wide. The cars are fitted with built-on containers which each hold approximately 3,500 lb. of Carblox carbon products and packing. The car schedule is one car per two hours, giving a total output of 100-140 tons per week, according to the type of material produced.

The kiln is of a special design and is capable of dealing with the volatiles given off from the green ware without resorting to any extra kilning space. This design enables a short operating cycle to be employed and appreciably steps up production. Automatic temperature control ensures suitable conditions throughout.



Side view of new tunnel kiln at Carblox (Loxley) Ltd. works, at Loxley, near Sheffield, showing cars with built-on containers in the foreground

maintained to limits of ± 10° C. Fourteen temperature recording points throughout the length of the kiln are connected to potentiometric recorders and controllers of the latest design.

The firing system is unique in that it has been designed primarly for oil-firing, using heavy fuel oil, but provision has also been made within the kiln structure to use part, or all, of the volatiles given off by the charge as an additional heating medium. The controls mentioned above, operate the oil fuel valves to give the correct firing temperature. Another interesting feature of the kiln is that there is no large brick-built stack. The control of the exhaust is effected by a venturi system which obviates the necessity for a large brick structure.

The kiln will be used for the production of all forms of carbon refractories, and will play an important part in increasing export business.

It is worthy of note that in addition to supplying the demands of the industry in the United Kingdom, that Loxley distributes these products to such widely separated places as Norway, Sweden, Finland, Portugal, Holland, Belgium, France, South Africa and Australia.

PROGRESS IN CERAMIC TECHNOLOGY—1951

IN the "Reports on the Progress of Applied Chemistry," Volume 36, 1951, published by the Society of Chemical Industry, 56 Victoria Street, S.W.1., Dr. James White reviews the progress made in ceramic technology in 1951. He deals firstly with the physico-chemical aspects.

On the subject of clays and raw materials he mentions that lower maturing temperatures as well as a demand for better thermal shock resistance and electrical properties have necessitated a closer control in the uniformity of the product, which in turn has led to the use of a finer particle size. The best United States felspars are being exhausted and Dr. White comments that English china clay is still regarded as most superior in vitrified and sanitary ware.

The low and even negative co-officients of thermal expansion of certain oxides of lithium, aluminium and silicon is mentioned, pointing out that workable deposits are at present available only in Sweden, West Australia and South-West Africa. Perlite rock can be expanded when heated at 1,900° F., and is finding use as a thermal insulator. Mention is made of a furnace with two zones whereby preheating occurs in the first zone at 600°-1,200° F. with elimination of some water, whilst expansion and dehydration occur in the second high temperature zone. Another furnace bloats the material by passing it in the gas stream through a furnace made of expanded perlite.

Referring again to the low expansion co-efficients of lithium aluminosilicates and their commercial production in America, reference is made to confirmation of the negative co-officient of expansion although as yet there is no explanation as to the reason for this peculiarity.

Other points referred to are the use of thermal analysis to study the kiln firing behaviour of clay bricks, the replacement of the felspar in white ware bodies by talc, which produced a progressive decrease in porosity and increase in strength. Alkali resistant vessels in which silica is replaced by titanium oxide giving a claimed resistance of twenty times that of porcelain or steatite bodies are mentioned. The practical use of electrically-heated moulds in tile pressing which prevent sticking by forming a steam layer at the mould surface is described. Reference is made to work on the theory of adhesion of enamels to iron whereby a mechanical mixture of two ground coats one containing cobalt and the other nickel enables changes at the interface to be observed by microscopic examination. Reference is also made to the colour instability of certain titanium opacified enamels.

In so far as refractories are concerned, American results indicate that the average life of the all-basic furnace is two to two-and-a-half times that of a silica furnace, but he mentions that with the six all-basic furnaces constructed in Britain since the war there are still considerable investigations required before they become really economical. On the question of special refractories to withstand the attack of highly reactive molten metals reference is made to the usefulness of cerium and thorium sulphides.

This is a most useful survey of developments in 1951 by Dr. White and is extremely well referenced.

Laboratory Control of Pottery Processes

AT the July meeting of the Stoke and Hanley Branch of the British Pottery Managers' and Officials' Association, a talk was given by Mr. D. G. Whittaker dealing with the question of laboratory testing and control.

Mr. Whittaker began by saying that although some form of control in testing had been done for many years, it was only fairly recently that organised laboratory control has come into popular favour and become considered an essential part of pottery production. He considered that it was fortunate that in the field of ceramics most of the routine tests such as that for specific gravity, moisture content, crazing, etc., are comparatively simple and do not require a lot of expensive apparatus, and that the training of staff to do these tests was not unduly difficult, although the training period was most important and merited much attention being paid to it to ensure the best results.

First Decisions

Due to the simplicity of these tests, a ceramic laboratory need not be expensive to maintain. The first point to be decided upon is the amount of control which the laboratory can cope with under the existing conditions of the factory, and also how much room can be spared for laboratory purposes and how much money can be expended upon apparatus.

All ceramic laboratories should keep a method book in which the details and method of procedure for all tests should be noted. There is only one way of doing each test and that is the correct way, and the same method must be carried out for every test on every occasion to ensure that a true comparison can be obtained from the results.

A data book should also be kept, usually by the chief chemist, and in it the result of every test carried out by the laboratory should be noted. From this book much information can be derived, and the results over a period of months can be easily compared and the required action taken upon any deviation from standard.

Sample Book

A sample book should also be kept, in which each sample brought into the laboratory for testing should be entered together with all possible data which can be obtained about each, e.g., in the case of a sample of flint from the grinding mill the date the sample was taken should be noted, cylinder number or grinding pan number, the running time in hours, the amount of water used, the amount of the charge, who the sample was taken by and any other relevant details should be entered. From this book, any query arising from the result of the test should be answered. Samples taken for testing should not be discarded immediately after the test, but should be kept until it is found that there is no need for rechecking results. The laboratory staff themselves should as far as possible take their own samples and not leave it to the operatives concerned, but where this was not possible, then at least an assistant should be present to ensure that the correct sample is taken. The sample should be representative of the whole, as if the sample is not correct then the whole of the fundamentals of the testing will break down. An example of this is in the case of cylinder-ground material; the required sample should be taken as soon as the mill stops before the material has time to settle, and it should be noted that the material should not be run off before the result of the testing is obtained. No

time should be wasted by further grinding as soon as the tests show that the required fineness has been obtained.

Mr. Whittaker also suggested that test sheets should be kept which should contain a note of all tests done, and these should be checked by the chief chemist. It was a good idea to have a stock of test sheets printed for every routine test done. A testing rota should also be drawn up, which should state at what intervals each of the various tests should be carried out. For example, crazing tests monthly, flint every three days, gas analysis of tunnel ovens weekly, etc. He said that testing limits was another factor to be decided upon. The first limit of error which is possible during testing was that due to the human error and of the apparatus itself, and when results do not come within these set limits, a further test must be made. The second limit was that of works processes and the maximum tolerance must be decided upon. Again in the case of cylinder grinding, if the results show that the material is on the coarse side, further grinding must be given, and if on the fine side, this must be rectified on the next charge. A graph showing the results of various charges should fall within the two set limits.

Object of Testing

He said that the object of testing was not merely to find the cause of any damage after it had been done, but also to prevent that damage from occurring, and this should save time, money and materials and produce a more stable product. The bulk of the testing on a normal factory was carried out on the mill processes, but it should be emphasised that all raw materials should be checked to see that they are up to standard, including those used in decorating processes. It was also a good idea for the laboratory to be responsible for the checking of all apparatus used on the works, and to keep a note of the standards desired. Such things as sliphouse pint weight cans and scales, colour scales, thermocouples and many others should be tested as a routine by the laboratory staff and a note of their condition kept. Vacuum gauges on pugs or pressures on compressors and similar items should also have a routine check. All work carried out by the laboratory staff is of no avail unless the best advantage is made of it by the work's staff, and a special point should be made when when a manager asks for a particular test, to see that he has a complete result slip containing all possible information presented to him. It is essential that liaison between works and laboratory is very close and thorough.

On the larger factories the work can be carried a step farther if a research chemist is employed. Work can be carried on from the development angle for such things as new glazes, substitute materials and the cutting down of costs; standardisation of results by substituting new and possibly synthetic materials for the existing variable ones. The smooth running of most works' processes depends on the accurate control of all materials used, although a balance must be struck between production requirements and testing requirements, and it is the duty of all laboratory staffs to ensure that interference with production by the taking of samples is kept to a minimum. He emphasised that laboratory control was only instituted to help the production side of the factory and not to hinder it, and that each individual manager should make sure that he takes full advantage of whatever tests his laboratory is capable of doing.

Finally, he pointed out that as the mass production of articles increased in the ceramic field, so would the control and testing of materials become of increasing importance.

THE AMERICAN CERAMIC SOCIETY

THE following titles are of papers appearing in the July, 1952, issue of the *American Ceramic Society Bulletin*: The Effects of Wetting Agents on the Physical Properties of Clay Bodies, by R. E. Pyle and P. R. Jones. Availability of Ceramic Raw Materials, by E. R. Killam. Some Common Sources and Causes of Stones in Glass from Continuous Melting Furnaces, by A. K. Lyle. Wollastonite Bodies as Low-loss Dielectrics, by Nicholas H. Snyder and John H. Koenig. Stability of Ceramic Materials, by J. F. Wygant and W. D. Kingery.

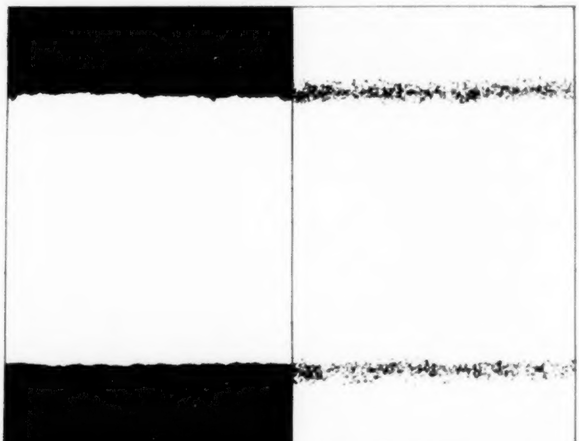
Radioisotope Study of Porcelain-Enamel Adherence

A CERAMIC or porcelain-enamel coating, to be effective, must adhere to the metal it is designed to protect. Cobalt oxide effectively promotes adherence of porcelain-enamel to iron, and for this reason has long been added to enamel ground (first) coats. Despite a great deal of research, however, the mechanisms by which cobalt oxide promotes adherence are not well understood.

Using very sensitive radioisotope tracer technique, the U.S. National Bureau of Standards has recently obtained new information on this important problem. The study, conducted by W. N. Harrison, J. C. Richmond and associates of the Bureau's enamelled metals laboratory, was part of a broad investigation—sponsored by the U.S. National Advisory Committee for Aeronautics—of the mechanisms involved in the adherence of porcelain-enamel and ceramic coatings.

Conventional porcelain - enamel ground coats usually contain at least eight components. In addition to cobalt oxide, oxides of iron and nickel are usually present. The physical and chemical properties of these oxides are quite similar, and the identification and quantitative estimation of small amounts of one of them in the presence of the others in such a complex system is difficult by ordinary chemical and physical means. For this reason practically none of the data previously reported has been obtained under conditions closely approximating those found in practice. By adding radioactive cobalt as a tracer to the frit (glass) used in the coating, the Bureau was able to obtain data on the mechanisms by which cobalt oxide promotes adherence of normally processed coatings of typical composition.

Studying the distribution of radioactivity in coated specimens after firing, it was found that a metallic cobalt layer was formed at the enamel-metal interface, and that near the interface the enamel layer was depleted in cobalt oxide. The amount of cobalt that thus migrated to the interface increased with increased firing, though the total quantity was extremely small—equivalent to a layer of metallic cobalt of the order of 0·01 micron (about 0·4 millionths of an inch) thick for normal firing. The cobalt deposit apparently did not



Left: photo-micrograph (× 50, unetched) of an enamelled-iron specimen in cross section. Right: enlarged (× 50) autoradiograph of same specimen (made by letting radiation from the specimen impinge directly on the photographic film)

penetrate into the enamelling-iron base during normal firing.

In the investigation, small specimens of 18-gauge enamelling iron were coated with a porcelain-enamel to which radioactive cobalt oxide had been added. After either under-firing (4 min. at 1,450° F.), normal firing (4 min. at 1,575° F.), or overfiring (6 min. at 1,750° F.), the specimens were de-enamelled with molten sodium hydroxide. Under the conditions of the experiment the sodium hydroxide readily dissolves the enamel and partially dissolves the iron oxides present at the interface, but the metallic iron and cobalt are not affected. After measurement of radioactivity of the specimens with a Geiger-Muller counter, the iron oxide layer was removed by agitation in ammonium citrate solution (which does not affect metallic cobalt), and the radioactivity was again counted. These measurements indicate the amount of cobalt present at the interface in metallic form (Table 1).

To study the cobalt distribution in the enamel layer itself, specimens were ground through from one side until almost all of the iron was removed. Treatment with a solution of iodine in potassium iodide removed the rest of the iron and also the metallic cobalt layer, leaving only a thin shell consisting of the iron oxide and enamel layers. The radioactivity of the resulting solution was checked for an indication of the amount of metallic cobalt at the interface, and radioactivity counts were made on each side of the chips of enamel. The iron oxide at the enamel-metal interface was then removed by solution in ammonium citrate, after which radioactivity counts were made of the ammonium citrate solution and again of the chips. These various measurements give a picture of the distribution of radioactive cobalt in the enamel layer (Table 2).

To obtain a picture of the cobalt distribution near the interface by a

TABLE 1.

RADIOACTIVITY COUNT ON METAL SPECIMENS ENAMELLED WITH RADIOACTIVE COBALT-BEARING ENAMEL, THEN RE-ENAMELLED.

Specimen No.	*Firing* treatment*	*Counts per min. after de-enamelling and removal of oxide*
1	U	180
2	U	189
3	N	1,788
4	N	2,345
5	O	2,759
6	O	2,685

*U Underfired, 4 min. at 1,450° F.
N Normally fired, 4 min. at 1,575° F.
O Overfired, 6 min. at 1,750° F.

The sample is inserted in the vertical lead shield or "lead pig" (left), which contains a Geiger-Muller tube. Radioactivity, as detected by the tube, is counted on the decade scaler (centre)

different technique, a normally fired specimen was mounted in plastics and ground at a slight angle to give a large-scale section through the interface and into the metal. An auto-radiograph of the section was then made by letting radiation from the specimen impinge directly on a photographic film that was in contact with the specimen. Like the other observations, the auto-radiograph shows that the radioactive cobalt concentrated at the interface but did not penetrate the metal.

TABLE 2.

RADIOACTIVITY COUNTS ON ENAMEL CHIPS AFTER REMOVAL OF METAL BASE.

Counts per minute per square inch

Specimen No.	*Firing condition**	*After iron removal* Inner face	Outer face	Diff.	*I-KI solution*	*After oxide removal* Inner face	Outer face	Diff.
1	U	15,755	18,484	14·8		4,090	4,813	15·1
2	U	16,474	19,659	14·8		3,205	3,594	10·8
Avg.				14·8	1,344			12·4
3	N	14,211	18,246	22·2		2,594	3,429	24·3
4	N	14,641	18,141	19·3		2,484	3,193	22·2
Avg.				20·8	1,664			23·2
5	O	9,339	14,100	33·8		1,917	1,926	
6	O	8,737	13,106	33·3		1,818	2,581	29·6
Avg.				33·6	2,784			29·6

* U — Underfired, 4 min. at 1,450° F.
N — Normally fired, 4 min. at 1,575° F.
O — Overfired, 6 min. at 1,750° F.

In another test of the degree of penetration, a normally fired specimen was de-enamelled with molten sodium hydroxide. After a count of its radio-activity, the specimen was then treated with ammonium citrate solution to remove the tightly adherent film of iron oxide, rubbed with a damp rag to remove any loose particles of cobalt metal, and again tested for radio-activity. The count was found to have been reduced 85 per cent. by this citrate-and-rubbing treatment of the surface, indicating further that there was very little penetration.

Substantial penetration of the iron base by the radioactive cobalt was observed, however, in a coated specimen that was heated in air at 1,300° F. for 270 hours after normal firing. When such a specimen, after de-enamelling, was treated with the ammonium citrate solution and rubbed with a damp cloth, the radio-activity count was reduced by only 10 per cent. An auto-radiograph likewise showed considerable radio-activity below the surface of the iron.

The cobalt deposit is believed to be metallic because it is removed with the iron base metal during the iodine-potassium iodide treatment, but is not completely removed by 65 hours of treatment with ammonium citrate. The experiments performed so far do not indicate whether the cobalt deposit consists of the pure metal or of an alloy with iron, nickel, or both. This may be clarified in future phases of the investigation.

CERAMIC PATENTS

TUNNEL Kilns for Ceramic Ware. B. J. Moore (B.P. 661,987; 8.4.49.)—Into an open-fronted combustion chamber a flame from a vertical burner is directed—the lower part of the setting of the combustion chamber is directly heated by the flame. The flames in turn pass upwards into an exhaust chamber where a thin wall acts as a muffle for heating the top of the setting, and the flames are then exhausted to a main flue. The open combustion chamber has a back wall which is inclined to the vertical so that the top is nearer to the tunnel wall.

Shaping. T. G. Green and Co. Ltd. (B.P. 657,544; 18.9.47.) This employs a roller tool which is the upper profile of the ultimate flat ware and is carried on the head of the jigger. The dia. is the same as that of the article at the point where it engages the outside edge of the article and this dia. gets progressively smaller from this outside edge terminating in a point at the centre of the article.

Trimming Ceramic Whole Ware. Wilkinson Bros. (Burslem) Ltd. (B.P. 661,781; 30.3.49.) Rotating spindles are carried on a turntable and the ware, such as cups, are supported on these spindles by suction. At a definite position during the rotation of this turntable the spindles themselves rotate with the cup and the periphery of the cup is thus trimmed with fixed tools. The foot and rim of the cup are also trimmed by other tools which rotate with the turntable again at a definite position in the rotation of the turntable.

Ceramic Articles. National Research Development Corporation. (B.P. 656,153; 6.4.48.) This defines an article which has high thermal shock resistance but in addition has various layers or zones which have a predetermined porosity. To make this article a slip layer of alcohol and a ceramic material such as alumina, and an organic material such as naphthalene is applied to the ceramic base—subsequently it is dried and fired to burn out all the organic matter and to sinter the remainder.

Ceramic Drying. W. A. Clements. (B.P. 656,695; 1.11.48.)—A horizontally built conveyor carries the ceramic filled forms through a hot air stream whilst another conveyor transverse to the first takes those filled forms when they are discharged from the first conveyor to enable the article to be removed from the forms by hand. Finally another conveyor takes the forms which are placed on the second conveyor and forwards them to the first conveyor.

Pottery Drying Stoves. J. and G. Meakin Ltd. (B.P. 656,952; 15.1.49.)—This consists of a casing having two openings on its side and in these there is placed a structure which is rotateable and such that it will support the cup moulds which face outwards. Below the structure in another casing the fan and heater are placed such that air is drawn downwards through the central structure, and the heated air is blown through nozzles

which are in various positions in ducts which in turn are arranged between the outer casing and the central structure. This hot air is blown into the cups as they rotate round the stove. Subsequently the cups are taken out through one opening—the moulds are then dried in the subsequent part of the circuit before reaching the other opening where they are withdrawn.

Firing Hard Porcelain. (U.S.P. 2,547,149; 3.4.51.)—Hardened enamel porcelain, after the biscuit baking, is fired at 1,000-1,200°C. in a reducing atmosphere followed by cooling at 700° per hr. to 700°C.

Insulating Firebrick. Morgan Crucible Co. (B.P. 661,607; 6.5.49.)—This defines a slip casting in a plaster mould of thixotropic slip made from a highly calcined refractory material such as alumina which contains fine iron particles and an acid. Additions of sawdust and plaster of Paris may also be made. A typical mixture would be alumina 95/100; plaster 0·0-5 per cent. and to this total weight is added 5-10 per cent. of sawdust of No. 4 mesh; 20-30 per cent. of water; 0·5-1·5 per cent. of concentrated hydrochloric acid or sulphuric acid; and from 0·05-0·5 per cent. of the weight of alumina as iron.

Refractory Tunnel Bricks. (B.P. 657,498; 12.7.48.)—This describes a porous brick made by moulding and firing at 1,500°C. a mixture of chromite up to 0·5 mm. in grain size and from 20-50 per cent. of raw magnesite. Part of the chromite may consist of crushed brick and some calcined materials whilst a foaming agent may be added.

BIBLIOGRAPHY ON INDUSTRIAL DRYING

IN three volumes, the Department of Scientific and Industrial Research have produced an extensive bibliography of references to industrial drying.

Although published in three volumes, there are really five sections, dealing with principles of drying, drying processes and equipment, agriculture, food and industrial materials.

In turn, these sections are subdivided to cover basic information, instrumentation and the practical aspects of the job in question. In all there are 1,768 individual references to publications and, since drying is an important aspect of practically every industry, the three volumes afford an excellent gallery of references up to 1950.

FOLK ART—CERAMICS

A RUMANIAN REPORT

THE Rumanian art of pottery, the same as the art of carpet-weaving, is one of the most remarkable expressions of Rumanian popular art. By its ornamental value, its harmony of colours, sheen of glaze, smartness of shape and simple beauty of decoration intimately adapted to form, Rumanian ceramics stand among the most effectual art expressions. Natural conditions favoured the development of the art, on both versants of the Carpathian range there are countless places rich in deposits of soft, plastic clay, easy to mould.

The Test of Time

The strictly utilitarian character of the craft soon combined with the pleasure of creating ornamental works. The humble clay vessels have stood the test of millenniums, furnishing first-hand reference on the peoples and settlements of those remote ages.

At the archaeological excavation site of Cleanov-Dolj, at Fiera Hill, where remnants were unearthed of primitive implements dating back to the matriarchal age of 50,000 years before our era, the middle strata disclosed fragments of earthenware of incontestable informative value.

The diggings, undertaken under the ruins of the former residences of ruling princes, at Targoviste; at Curtea de Arges (the first Wallachian capital); at Suceava (the ancient capital of Moldavia), at the old residential palaces of the princes Brancoveanu and Cantacuzino, at Mogosoaia, Obilesti, Magureani and Margineni; around ancient monastries and at places of old potters' settlements, yielded countless earthenware relics.

The abundant finds testify to the existence in the Rumanian past, of a developed ceramic art which, while maintaining ancient national traditions of work, was at the same time subject to foreign influences, among them to the ceramics of Persian provenience, imported in the course of the 17th and 18th centuries.

The active relations that existed between the Rumanian and the Slav peoples, the trade exchanges carried on among them through the successive historical periods, enriched the Rumanian patrimony of ceramic art by way of strong Slav influences. Thanks to this fact, and to the Byzantine influence, the colours range of Rumanian pottery acquired new brilliancy and its decoration schemes increased with new elements, which, have subsisted unaltered to this day.

During the 17th and 18th centuries the Germans and Hungarians of Transylvania organised, in the proximity of Rumanian ceramics centres, such centres of their own, to which they brought masters from Bohemia whose art and technique most certainly influenced the local craft.

A series of internal influences, as, for example, those of tramp craftsmen, also contributed to interpenetration among the different regions, leading to modifications of specific local art.

Classification by Regions

Although such factors render difficult a rigorous classification per specific types as to shape and decorative design, we will sketch here a classification by separate regions.

The ceramics of the Oltenia province certainly stands highest in excellence, by its variety of shape and richness of decoration motives. Its shape is more pure than that of other regions, its surface is thinner, the paste is finer.

The controlling idea in decoration is frequently zoomorphic or floral, but more commonly they follow a linear or geometrical design.

A far-off Persian influence is evident in the specimens manufactured at the important ceramics centre of Horez, by its predilection for green, red and dark brown on a white ground.

The decoration practised at the Oboga centres is of white and black on red slip or else black and red on white slip.

The ceramics of Wallachian make is characterised by the predominance of the Byzantine type, going together with ancient prehistoric and Roman styles. Indeed, excavations effected in the area of the old Wallachian capital at Curtea de Arges, prove the existence at the time of the centre there, of Byzantine ceramics.

It is there, at Curtea de Arges, that there appeared much later, the decoration technique by brush, at the same time with the quillnib cornet and the graining-comb.

The Moldavian ceramics, which, in the centres of the Moldavian foot-hills has preserved the prehistoric tradition of black or grey coloured vessels, is the plainest from the point of view of ornament.

The ceramics made in Maramures province, the same as the carpets made there, follow in artistic value, immediately next to those of Oltenia. In variety and beauty they compare with the best specimens of Oriental ceramics. Being designed almost exclusively to ornament house interiors, the uncommonly large plates made there are provided with a device allowing their being hung on the wall. Usually, the decoration design is sharply incised with a knife and the grooves painted by brush in highly shining colours: two different shades of green and yellow, then blue, brown and a red different from any used in other regions. The current anthropomorphic, zoomorphic and floral motives, delicate and original in execution, testify to exceptional artistic gift.

On the Transylvania table-land are interspersed influences from the ceramics of the different national population of the region: German about the city of Stalin, Sibiu and Bistrita; Hungarian about the towns of Cluj and Targu-Mures; Rumanian in the mountain areas.

The former is characterised by a glazed design of fine white lines; in the next the brown predominates on a grounding of violet-brown decorated in green. The one from which blue is almost never absent is the Rumanian style.

Despite diversity of detail and the varied influences undergone, Rumanian ceramics preserves none the less a strong aspect of unity; the pottery of present-day Rumanian manufacture are so strikingly alike to those of many centuries back, revealed by archaeological excavations, that you can hardly tell the latter from the former.

W. E. Maddock. Mr. William Edward Maddock, who died on 18th July, aged 78, was for many years a director of the Burslem pottery firm of John Maddock and Sons Ltd., with which he was associated from 1888 until the time of his death. Mr. Maddock took a keen interest in poetry and composed many poems himself over a long period of years.

W. P. Wood. The death of Mr. William Percy Wood, at the age of 76, was announced on 20th July. Mr. Wood, who was managing director of Hollinshead and Kirkham Ltd., pottery manufacturers of Tunstall, had spent more than sixty years in the industry. He was a member of the Export Earthenware Manufacturers' Association.

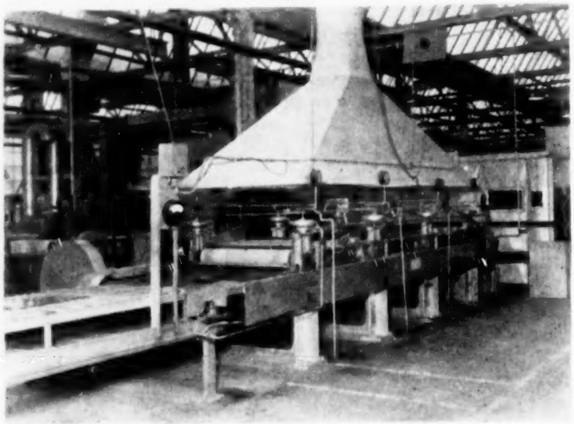
SAFETY GLASS PRODUCTION

AN interesting and perhaps little-known application of the use of infra-red energy is in the production of safety glass at the Triplex Safety Glass Co. works, near Birmingham.

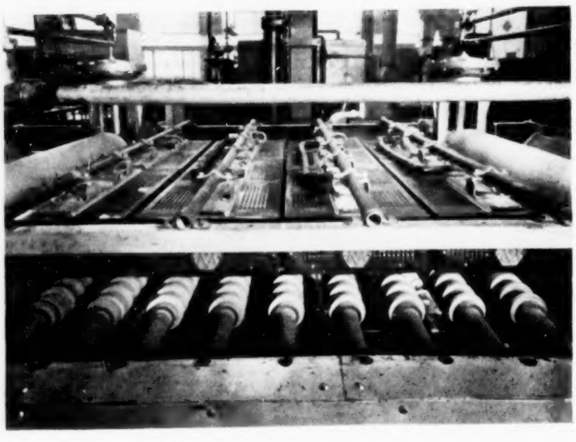
In the manufacture of laminated safety glass, a Vinyl interlayer is placed between two glass sheets and preliminary adhesion is obtained by applying heat and pressure.

The two panes of glass and the Vinyl interlayer are assembled on a conveyor belt which passes through the assembly room, the two panes being located relative to each other by special templates which ensure that the edges are in exact alignment. The assembly is then passed through a series of rubber-covered pressure rollers which cause initial adhesion between the glass and the Vinyl, and during this process heat is applied by electric infra-red units.

Final adhesion is obtained by placing the glass in autoclaves where it is



Manufacture of Triplex safety glass using Metrovick electric infra-red projector units



These Metrovick electric infra-red projectors provide heat for initial adhesion between glass and interlayer for laminated safety glass

subjected to predetermined pressure and temperature.

The infra-red units include the new Metrovick electric infra-red projectors fitted with tubular sheathed elements which operate at red heat. These elements consist of a spiral of high-grade heat resisting wire tightly embedded by a special process in a mineral insulator, enclosed solidly in a tight sheath of $\frac{5}{16}$ in. tube of a non-scaling, non-corrodible alloy. The process ensures that the spiral is held immovable in the centre of the bore so that an even thickness of insulation separates it from the sheath. The projectors themselves consist of a trough reflector in a robust frame designed for maximum strength consistent with light weight. The reflectors are constructed from high-grade aluminium sheet which has been subjected to a special anodising process to give maximum heat reflection and to protect them from atmospheric corrosion. These projectors form clean and efficient units adaptable to any production line, enabling an intense energy concentration to be obtained where required.

JOHNSON MATTHEY & CO.

(South Africa)

JOHNSON MATTHEY and Co. propose to form a subsidiary company in South Africa under the title of Johnson Matthey and Co. (South Africa), with offices in Johannesburg. The initial objectives will be to meet from local production South Africa's industrial needs for noble metals, and to manufacture the requirements of the jewellery, dental and allied trades.

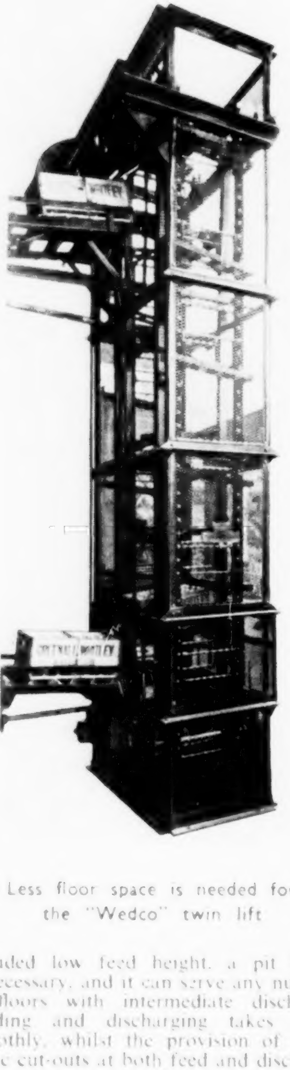
Mr. G. A. Shaw, assistant manager of the Shepherd's Bush works of the company, has been appointed manager, and will leave for South Africa in September, with Mr. C. F. Deering, a director of the London company.

"WEDCO" TWIN LIFT

A NEW machine that has been designed to elevate cases, cartons, crates, bales, barrels, etc., from floor to floor is being manufactured by The British Wedge Wire Co. Ltd., of Warrington.

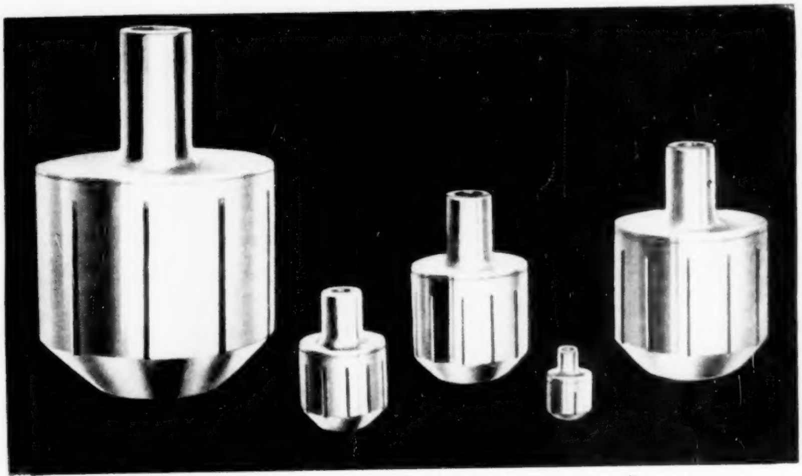
Known as the "Wedco" twin lift (Prov. Pat. No. 13,287/52) it requires only half the floor space required by a swing tray elevator and, operating between gravity roller conveyors, it will elevate approximately 720 articles per hour with a completely automatic feed and discharge.

Among the advantages claimed are included low feed height, a pit being unnecessary, and it can serve any number of floors with intermediate discharge. Feeding and discharging takes place smoothly, whilst the provision of automatic cut-outs at both feed and discharge ends, eliminates the danger of jamming. It can be supplied to discharge on the same side as the feed or on the opposite side.



Less floor space is needed for the "Wedco" twin lift

Glass Technology Appointment.—Dr. A. C. Waine, director of research of the Triplex Safety Glass Co. Ltd., of King's Norton, Birmingham and Willesden, N.W., has been appointed chairman of the Society of Glass Technology (Midland section) for the coming year.



The range of Premier dispersators from 1 in. to 6 in. diameter

MIXING EQUIPMENT

IN practically every industry the question of mixing and spreading to give a homogeneous mixture is of primary importance. Thus, the announcement of Premier Colloid Mills Ltd., Brettenham House, Lancaster Place, London, W.C.2, of their new dispersator, is of interest. The claimed features of the design are to give maximum turbulence and contact between various phases more effectively than by a marine type propeller.

Essentially the equipment consists of a drum rotating at high speed, and the centrifugal force from this high-speed rotation forces the products outwards through narrow slots in the wall of the drum under considerable pressure: the product is sheared at high speed and the columns of liquid emerging from the slots are further sheared in coming into contact with the slower moving mass of liquid in the vessel. Our illustration shows a range of dispersator heads which are available.

REFLECTIVE FINISHES

REFLECTIVE finishes developed by Safeticurb Ltd., of 65, Bath Street, Glasgow, have already proved their value on road signs, as a marking system for aircraft landing fields, and in a wide variety of similar applications.

The basis of the system is the use of a multiplicity of spherical glass beads of minute size suitably bonded to a body which is illuminated and easily identified by vehicle lights in darkness. Satisfactory bonding liquids have been achieved permitting the use of this new finish on metal, timber, and other materials.

Demonstrating the effectiveness of the reflective finishes as applied to road signs

FUSED QUARTZ WOOL

THE production of fused quartz wool was demonstrated at the recent Institute of Physics Exhibition in Glasgow by the Thermal Syndicate Ltd., of Wallsend, Northumberland. This important technical development created considerable interest among physicists attending this important gathering, and samples were taken for industrial testing in a variety of processes.

Fused quartz wool is a development from the company's fused quartz fibre and is a featherweight ultrafine high temperature insulating material whose uses in high temperature techniques is now being developed. Average size per strand is six microns and the cost is in the region of £20 per lb. The Thermal Syndicate claim to be the only firm in the United Kingdom producing this material on a commercial basis.

Another interesting product shown at this display was the company's new Thermal Spinel, an interesting new refractory material derived from a composition of thermal alumina and thermal magnesia at very high temperatures. This highly refractory material has good resistance to basic slags and coal ash and is being marketed in lump and powder form according to requirements.

Sturtevant Literature. Publication No. 3,201 on "Axial Flow Fans" is available from Sturtevant Engineering Co. Ltd., Southern House, Cannon Street, London, E.C.4. Physical data on these aerofoil blade fans are given and their performance characteristics. Illustrations and line diagrams are provided together with information needed when ordering.

ADVERTISERS' INDEX

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